

4:2:0 (not depicted in FIG. 8), and the distortion this introduces, may also be considered in this step, as discussed in previous sections.

[0090] Similarly, in the constant luminance domain, Y in the linear domain is first calculated as $Y = M[1,1] * R + M[1,2] * G + M[1,3] * B$ and then Y' in the transfer domain is calculated as $Y' = TF(Y)$. Then the quantized value of Y', Cr', and Cb' may be calculated as described above for the non-constant luminance case.

[0091] The decoder or receiver may inverse these processes as necessary to generate recovered color components.

[0092] As shown in FIG. 8, the Y component may additionally be encoded and decoded at block 820 to account for compression loss due to a lossy compressor, such as coding engine 108 of FIG. 1, when calculating the Cb/Cr components.

[0093] According to an embodiment, any error introduced in previously quantized and processed color components can be fed into later quantized and processed color components. By changing the order of the component calculation to compute different components first, and then use that information to calculate the other components: the 1) quantization error 2) compression error and/or 3) chroma subsampling error of any one component may be considered in the creation of the remaining components.

[0094] For example, Cb may be calculated as $Sb * M[1,1] * R - Sb * M[1,2] * G + (Sb - Sb * M[1,3]) * B$. Then Y is calculated as $Y = B - Cb / Sb$ and Cr is calculated as $Cr = (Sr - Sr * M[1,1]) * R - Sr * M[1,2] * G - Sr * M[1,3] * B$. Similarly, Cr may be calculated first, then Y and then Cb or Cr may be calculated next, then Cb and then Y, etc.

[0095] The above steps could be applied on other color spaces and not only Y'CbCr data. Other spaces may include, for example, the Y'u'v', Y'u"v", and IPT color spaces among others. Intermediate conversion to other color spaces, such as XYZ or LMS may be required for this conversion. These steps could be combined with all other methods discussed in all other sections of this disclosure.

[0096] General Considerations

[0097] Each of the processes described above may be applied in alternative color spaces including YUV, Y'u'v', XYZ, Y'dzdx, Y'u"v", IPT, LAB, etc.

[0098] According to an embodiment, the encoder may transmit information with the coded video data in logical channels established by the governing protocol for out-of-band (side-information or side-info) data. Such information may include filter selection, quantization parameters, and other hint information. As one example, used by the H.264 protocol, the encoder 200 may transmit accumulated statistics in a supplemental enhancement information (SEI) channel specified by H.264. In such an embodiment, processes introduce the information in a logical channel corresponding to the SEI channel. When the present invention is to be used with protocols that do not specify such out-of-band channels, a separate logical channel for the noise parameters may be established within the output channel.

[0099] Although the foregoing description includes several exemplary embodiments, it is understood that the words that have been used are words of description and illustration, rather than words of limitation. Changes may be made within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the disclosure in its aspects. Although the disclosure has been described with reference to particular means,

materials and embodiments, the disclosure is not intended to be limited to the particulars disclosed; rather the disclosure extends to all functionally equivalent structures, methods, and uses such as are within the scope of the appended claims. For example, embodiments of the present invention may provide a method of coding; a non-transitory computer readable medium storing program instructions that, when executed by a processing device, causes the device to perform one or more of the methods described herein; a video coder, etc.

[0100] As used herein, the term "computer-readable medium" may include a single medium or multiple media, such as a centralized or distributed database, and/or associated caches and servers that store one or more sets of instructions. The term shall also include any medium that is capable of storing, encoding or carrying a set of instructions for execution by a processor or that cause a computer system to perform any one or more of the embodiments disclosed herein.

[0101] The computer-readable medium may comprise a non-transitory computer-readable medium or media and/or comprise a transitory computer-readable medium or media. In a particular non-limiting, exemplary embodiment, the computer-readable medium may include a solid-state memory such as a memory card or other package that houses one or more non-volatile read-only memories. Further, the computer-readable medium may be a random access memory or other volatile re-writable memory. Additionally, the computer-readable medium may include a magneto-optical or optical medium, such as a disk or tapes or other storage device to capture carrier wave signals such as a signal communicated over a transmission medium. Accordingly, the disclosure is considered to include any computer-readable medium or other equivalents and successor media, in which data or instructions may be stored.

[0102] The present specification describes components and functions that may be implemented in particular embodiments which may operate in accordance with one or more particular standards and protocols. However, the disclosure is not limited to such standards and protocols. Such standards periodically may be superseded by faster or more efficient equivalents having essentially the same functions. Accordingly, replacement standards and protocols having the same or similar functions are considered equivalents thereof.

[0103] The illustrations of the embodiments described herein are intended to provide a general understanding of the various embodiments. The illustrations are not intended to serve as a complete description of all of the elements and features of apparatus and systems that utilize the structures or methods described herein. Many other embodiments may be apparent to those of skill in the art upon reviewing the disclosure. Other embodiments may be utilized and derived from the disclosure, such that structural and logical substitutions and changes may be made without departing from the scope of the disclosure. Additionally, the illustrations are merely representational and may not be drawn to scale. Certain proportions within the illustrations may be exaggerated, while other proportions may be minimized. Accordingly, the disclosure and the figures are to be regarded as illustrative rather than restrictive.

[0104] For example, operation of the disclosed embodiments has been described in the context of servers and terminals that implement encoding optimization in video